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UNITED STATES DEPARTMENT OF AGRICULTURE

FOREST SERVICE

PROGRESS REPORT

COLONIZATION OF FOREIGN INSECT PREDATORS IN 1958 FOR CONTROL OF THE BALSAM WOOLLY APHID

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SUMMARY

A program started in 1957 to introduce foreign predators of the balsam woolly aphid into the Pacific Northwest was continued and expanded in 1958. Six species of predators, five from Europe and one from Japan, were imported. The European predators were provided by the Canadian Department of Agriculture from collections made by representatives of the Commonwealth Institute of Biological Control. Arrangements with Canada to provide and ship the insects were made by the Washington offices of the Branch of Research of the U. S. Forest Service, and the Entomology Research Division of the Agricultural Research Service.

Japanese collections were made by Mr. P. B. Dowden of the Northeastern Forest and Range Experiment Station who spent the summer of 1958 in Japan making a survey of possible predators. He collected a total of three species for shipment. Two were sent to Canada and one to the Insect Identification and Parasite Introduction Laboratory of Agricultural Research Service at Riverside, California, for propagation. Several small colonies of the Coccinellid sent to Riverside were reared by Mr. B. Puttler and shipped to Oregon for release. A summary of the predators colonized in Oregon and Washington in 1958 follows:

Species	Source	No. colonized
Laricobius erichsonii (Coleoptera: Derodontidae)	Czechoslovakia	8,525
Aphidoletes thompsoni (Diptera: Itonididae)	Czechoslovakia	2,480
Aphidecta obliterata (Coleoptera: Coccinellidae)	Sweden	720
Neoleucopis obscura (Diptera: Chamaemyiidae)	Maine (Europe)	700
Cremifania nigrocellulata (Diptera: Chamaemyiidae)	Czechoslovakia	385
Chilocorus kuwanae (Coleoptera: Coccinellidae)	Japan	135
	Total	12,945

Predators were released in the Willamette Pass, Black Rock, and Corvallis areas in Oregon and the Mount St. Helens and Wind River areas in Washington. By fall, two of the predator species were at least temporarily established: L. erichsonii had produced progeny at five of six release points and A. thompsoni at the only release point. Establishment of A. thompsoni was also found at a 1957 release point. Possibilities for recolonization from this area in 1959 appear good.

The predators were received as adults, except A. thompsoni which was shipped from Czechoslovakia in the mature larval and pupal stages. It was reared to the adult stage at the Sellwood laboratory in Portland. Shipments of the various species were frequently split into smaller lots before release. Some predators were released in cages and some free. Successful establishment has occurred with both methods.

The predator introduction program continued to be a cooperative undertaking with Oregon State College. Considerable assistance was also secured from entomologists of Weyerhaeuser Timber Company who helped in selecting release sites, releasing predators, and evaluating establishment.

INTRODUCTION

The following report describes the introduction and colonization in 1958 of six species of foreign insect predators for control of the balsam woolly aphid (Chermes piceae Ratz.) in Oregon and Washington. The work reported is a continuation of the predator introduction program started in 1957 when infestations of the aphid reached some 600,000 acres in size and widespread tree-killing was in progress. Results of the 1957 work have been reported.1/

1/ Wright, K. H. and Mitchell, R. G. Progress Report: Colonization in Oregon and Washington of Aphidoletes thompsoni - An European Predator of the Balsam Woolly Aphid. Pacific Northwest Forest and Range Experiment Station, Portland, Oregon, Feb. 1, 1958.

Introduction of the predators has been possible through the generous cooperation of Science Service, Canadian Department of Agriculture and their affiliate, The Commonwealth Institute of Biological Control. Arrangements with Canada for importation of European predators were made by the Branch of Research of the U. S. Forest Service and the Entomology Research Division of the U. S. Agricultural Research Service. Representing Canada in the cooperative agreements was Dr. P. B. Beirne, Officer-in-Charge of the Forest Entomology Laboratory at Belleville, Ontario. The Pacific Northwest Station is indebted to P. B. Dowden of the Northeastern Forest Experiment Station who made predator collections in Japan. Grateful acknowledgment is also made to J. K. Holloway, B. P. Puttler and others of Agricultural Research Service who assisted in handling, rearing, and expediting the predator shipments. Considerable technical and field assistance in handling and releasing the colonizations was provided by Dr. J. A. Rudinsky of Oregon State College, and N. E. Johnson and J. Winjum of the Weyerhaeuser Timber Company Forestry Research Center at Centralia, Washington.

COLONIZATION PROGRAM IN 1958

Shipments of predators began arriving on May 19 and continued at various intervals until August 27. All shipments were processed at the Sellwood laboratory in Portland, where improved facilities for handling them were constructed following the 1957 season. Rearing and distribution of the predators were made from this central facility.

Following are details of the collection, shipment, and colonization of the six species of foreign predators received in 1958.

Laricobius erichsonii Rosenh. (Coleoptera: Derodontidae)

Collection and Shipment - The predators were collected in the adult stage in the vicinity of Cemjata, near Presov, Czechoslovakia, by Dr. H. Zwölfer of the Commonwealth Institute of Biological Control, and Czechoslovakian assistants. They were shipped by air freight from Presov to the Canadian Science Service laboratory at Belleville, Ontario, via London and Montreal. At Belleville, the beetles were fed a honey-agar mixture for 2 to 3 days at 68° F. before reshipment by air express to Portland.

Four shipments, totalling 8,650 specimens were received at Portland. The first arrived on May 19 and the last on May 29 (see table 2 in appendix). The shipments arrived in good condition; mortality ranged from 1 to 15 percent, with an average of about 10 percent for the 4 lots. Shipping boxes were the standard wood type used by the Commonwealth Institute of Biological Control (figure 1), and were much the same as those in which *Aphidoletes thompsoni* were received in 1957.

Some alterations, however, had been made in the box to accommodate Laricobius. The interior sides of the double-wall boxes were made of wood, but the bottoms were covered with a very fine metal screen, and the removable tops were of heavy clear plastic. Damp cotton had been placed between the screening and the bottom of the box to provide favorable humidity.

Food was provided for the beetles. The technique for doing this was as follows: On each of two interior sides of the box, a sheet of porous paper approximately 2.5 x 4.0 inches had been stapled. On the paper at about one-half inch intervals, blobs of a granular, sticky material (believed to be honey-agar), about one-fourth inch in diameter was provided (figure 1). When the boxes were first opened, groups of 3 to 6 beetles were noticed congregating on this material, apparently feeding.

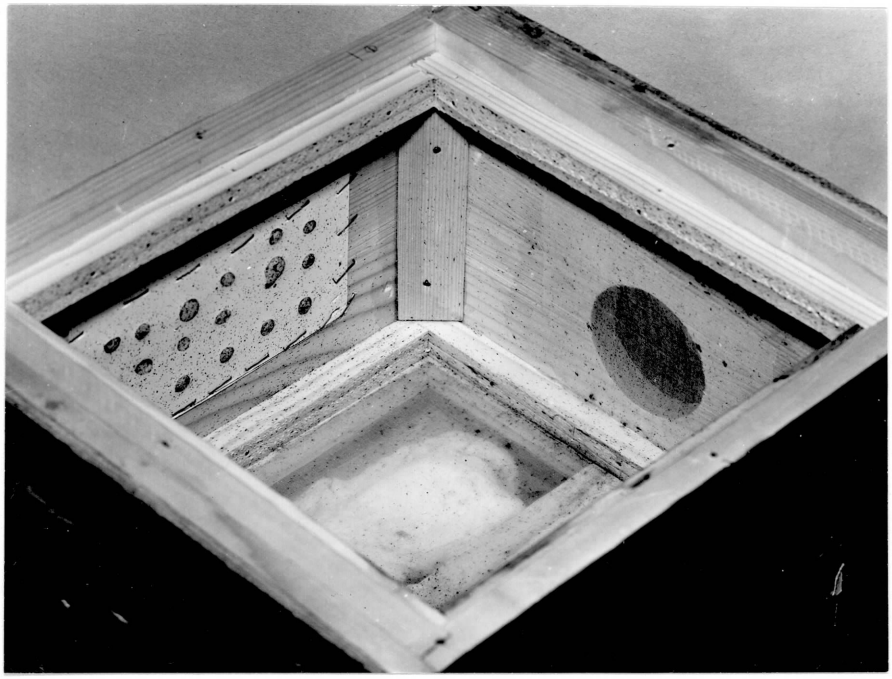

Figure 1.-Interior of shipping box used for Laricobius, showing placement of blobs of food, and moist cotton under screen false bottom.

After careful examination of the condition of the beetles, they were stored in a refrigerator at 48° F. until time for release. Frequent copulation was observed throughout the period they were held in the shipping boxes.

Releases - Of the 8,650 adult Laricobius erichsonii received, 8,525 were released in the field, while 125 were kept at the Sellwood laboratory for photography and experimental purposes (table 2). Each shipment was released as one colony except for the first which was divided into three lots. The aspirators used in 1957 for separating proctotrupid parasites from Aphidoletes rearings were used to separate lots of approximately 400 beetles. The aspirating was done by opening the door of the refrigerator where the beetles were stored, setting the opened box on the bottom shelf, and aspirating the beetles into large shell vials. When the insects became too active to handle readily, the refrigerator door was closed until they become quiescent from the cold.

Two methods of releasing these beetles were used -- cages and free releases. The cages used were the large sleeve type of plastic screen and muslin used last year for releasing Aphidoletes. The free releases were made as shown in figures 2 and 3. The 3/4-inch plywood shelf shown in these figures was about one foot square, except for the sides which were cut to fit approximately the periphery of the bole of the tree. The shelf was supported by a small piece of 2 x 4, through which a single large spike was driven radially into the tree. The box was made secure by wrapping heavy cord around the tree and the box.

Soon after attaching the box to the tree, some beetles flew immediately to the bark surface, while others crawled out slowly. In a few days, some of the beetles were noticed to have flown to adjacent trees infested with the balsam woolly aphid.

The 8525 L. erichsonii adults were released in Oregon and Washington by areas as follows:

Corvallis, Oreg.	1705
Black Rock, Oreg.	1550
Willamette Pass, Oreg.	1200
Coldwater Creek, Wash.	1320
Green River, Wash.	1600
Wind River, Wash.	1150
Total	8525

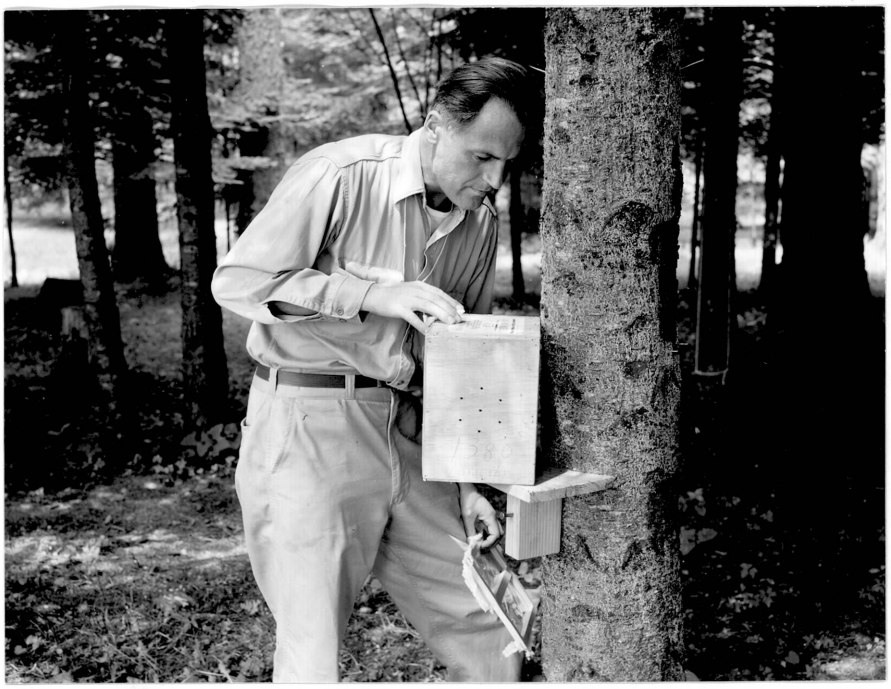

Figure 2.-Releasing Laricobius erichsonii on a chermes-infested grand fir near Corvallis, Oregon.

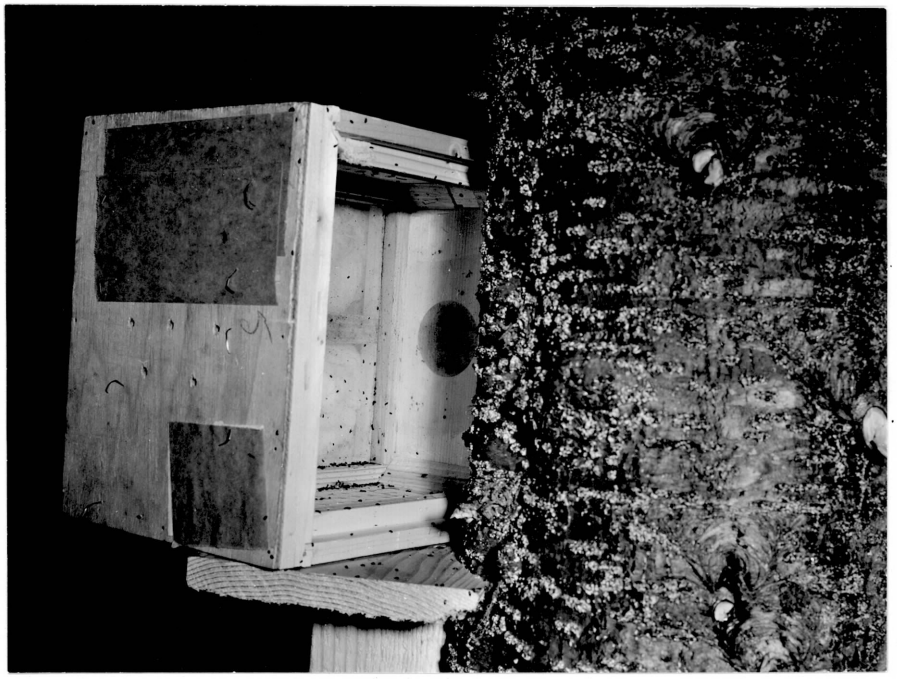

Figure 3.-Adults of Laricobius erichsonii leaving shipping box attached to chermes-infested subalpine fir.

Observations following release - Larvae of Laricobius erichsonii were found preying on chermes on at least one tree at all release points except the one at Wind River. At this location, the release tree died about mid-summer; however, another heavily infested tree is only a few feet away from the release tree, and it is possible that Laricobius may be established on it. Following is a summary of recoveries at the various release points.

Table 1.--Recoveries of Laricobius erichsonii on release trees in Oregon and Washington.

Area	No. release trees	No. trees with Laricobius	Date of last finding
Corvallis	2	1 (Also on several trees in vicinity)	July 8
Black Rock	2	2	July 7
Coldwater Creek	1	1	July 10
Green River	2	1	Aug. 14
Willamette Pass	1	1 (Also on several trees in vicinity)	Oct. 18
Wind River	1	0	---

Adult beetles were found on August 14 at Green River and October 18 at Willamette Pass. All other findings were of larvae. It is believed that the adults found in late summer and fall are progeny of the released beetles. In Europe and Canada the progeny emerge, after pupation in the soil, to feed as immature adults during the summer and fall. They then return to the forest floor to overwinter, and are sexually mature when they emerge the following spring.

Laricobius was observed to prey heavily on its host (figure 4). In the laboratory, a last-instar larva destroyed 7 eggs and 1 adult during a 1-1/2 hour period. In the field the effects of predation were apparent within a month. In their searchings for prey, the larvae tear up the wool of the host in a spectacular manner.

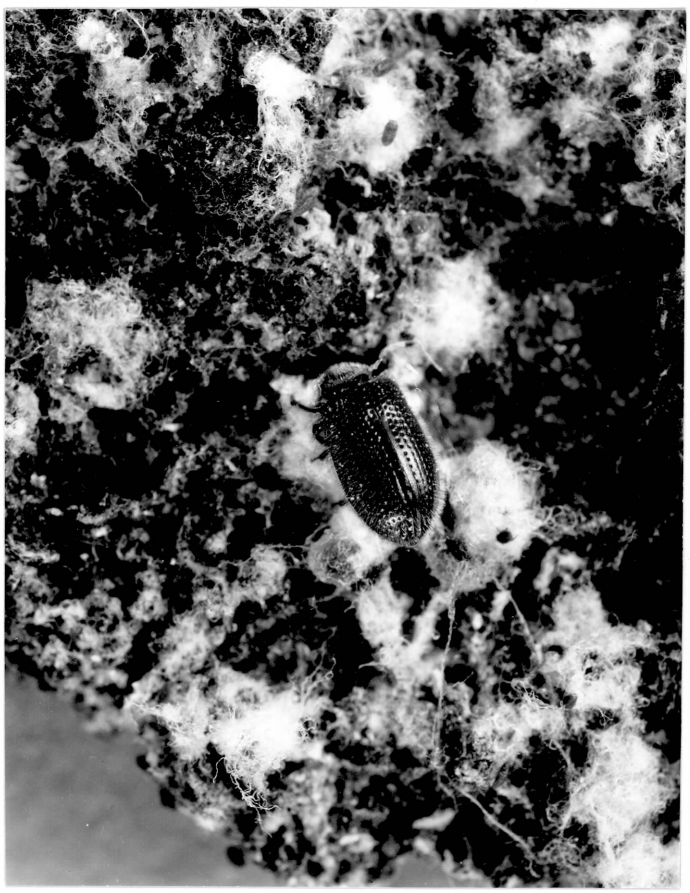

Figure 4.-Adult of Laricobius erichsonii preying on bole infestation of Chermes piceae (x 11).

Aphidecta obliterata (L.) (Coleoptera: Coccinellidae)

Collection and Shipment - All Aphidecta were collected in the adult stage at Visingso, Sweden, by Dr. H. Pschorn-Walcher of the Commonwealth Institute of Biological Control. The beetles were shipped from Jonkoping, Sweden, to London by Scandinavian Air Services, from London to Montreal by British Overseas Airways Corporation, and from Montreal to Belleville by Canadian National Railway. The beetles were sent by Air Express from Belleville to Portland. Total elapsed time for a shipment can be seen from the following schedule for importation number 58-20: Dispatched Jonkoping, Sweden, on May 24; arrived Belleville, May 27; left Belleville, May 27; arrived Portland, May 31. Usually, travel from Belleville to Portland was nearer 2 days than the 4 in this instance.

Aphidecta was the second European predator received during 1958. Four shipments, beginning May 31 and totalling 720 adults, were received and released (see table 2 in appendix). Upon arrival at Portland, the beetles were stored at 48° F. until taken to the field for release. All four shipments arrived at Portland in excellent condition.

Releases - All releases of Aphidecta were free (table 2), and the same method as that for Laricobius was used. Releases of 295 adults were made near Corvallis, Oregon, and 325 in the Green River drainage in Washington.

Observations Following Release - Adults of A. obliterata were seen copulating on the tree soon after release, and many of the adults fed for several weeks. However, only one larva and several eggs were found on the release tree at Green River, and no progeny were found at Corvallis. On the release tree at Green River the eggs were found on lichens and moss, mostly that which extended some distance from the surface of the bark. Unfortunately, this tree was killed late in the season by Pseudohylesinus grandis bark beetles. It is quite likely, however, that some of the released beetles flew to surrounding trees where light to moderate bole infestations were present.

Aphidoletes thompsoni Mohn (Diptera: Itonididae)

Collection and Shipment - This predator was collected and shipped in the mature larval stage. Dr. H. Zwölfer and Czechoslovakian assistants collected the material at Bresony, Lipovce, and Sindhor, East Slovakia, Czechoslovakia. The material was shipped from Presov, Czechoslovakia by air freight on June 24 and arrived in Belleville on June 27 via London and Montreal. The total shipment was divided at Belleville and some 10,000 were dispatched by air express to Portland, arriving June 29 (table 2).

The shipment arrived in the usual C.I.B.C. shipping boxes, with the insects dispersed in course sand in six cotton-stoppered 4-inch shell vials. A considerable number of the Aphidoletes in each vial had congregated around the bases of the cotton stoppers, and a number were crushed between them and the walls of the vials. It was observed that at least 80 percent of the insects were still in the larval stage. Some larvae were spinning cocoons and were obviously approaching the prepupal stage (figure 5). The sand in the vials was still damp and friable, and the predators appeared to be in generally good condition.

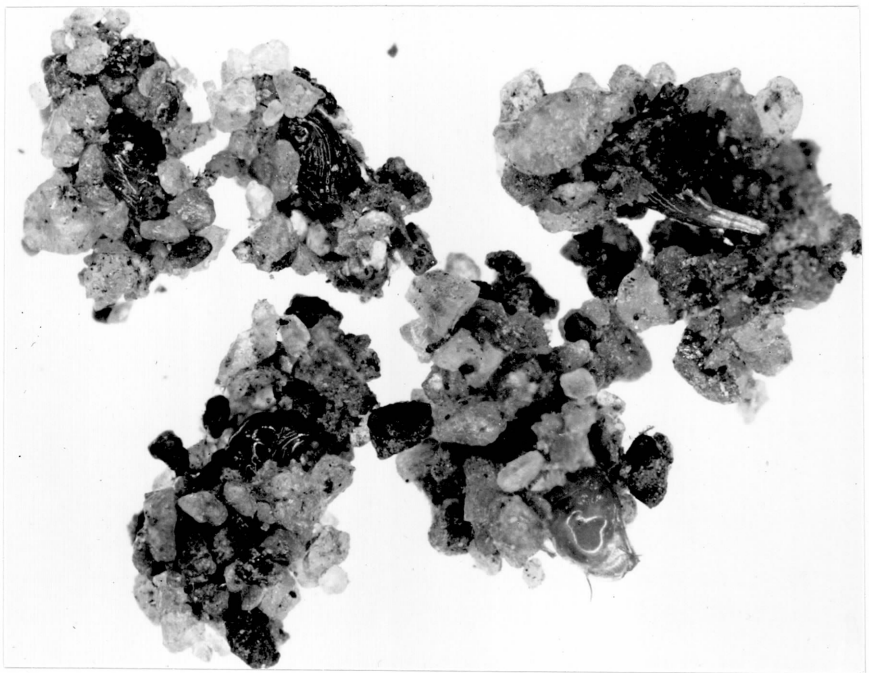

Figure 5.-Aphidoletes thompsoni cocoons of silk and soil particles.

Laboratory Rearing - After examination of the shipment on June 29, it was felt that additional time should be allowed for pupation before placing it in emergence cages. Accordingly, the vials containing sand and predators were held in a refrigerator at 50° F. until July 2. On this date the contents of the 6 shipping vials were placed in six ice-cream-carton rearing cages. Cage number 6 did not receive the full complement of material because a small portion was withheld for photographs and experimental purposes.

The rearing setup used is shown in figure 6. The six cages in which the mixture of sand and Aphidoletes was placed represented two different types as follows. Three of the cages were unaltered quart-size, wax-lined ice-cream cartons. The other three cages were the same type, but approximately one-fourth the circumference of the cartons was removed and replaced with muslin cloth and secured by glue. It was thought that by placing the muslin-side of the cages on damp sand in a sand table, more desirable moisture conditions could be maintained within the cages. Each cage was fitted with a 4-inch 25 mm. shell vial, with both ends open to prevent condensation. The ends of the vials protruding from the cages were covered with muslin cloth and secured with a rubber band.

Because cages placed in damp sand produced the best emergence in 1957, this medium was used exclusively in 1958. The sand in the rearing tables was kept moist by periodic watering, and moisture was also added to the soil inside the cages by using a fine-spray, bulb-type atomizer. The amount of moisture added to the cages during the rearing period varied with room temperature and humidity as recorded on a hygrothermograph. Humidity averaged 70 to 80 percent immediately above the sand table and the temperature ranged between 68° and 84° F., with an average for the heavy emergence period (July 12-16) of 75°. Two hinged desk lamps containing two 20-watt fluorescent tubes were used to draw off the emerging Aphidoletes. The rearing room used this year was located in the basement of the laboratory and proved to be much more satisfactory from a temperature and humidity standpoint than the one used on the first floor in 1957.

Figure 6.-Facilities for rearing Aphidoletes thompsoni at Sellwood laboratory.

When about 5 or more predators had emerged into the vials, they were removed from the cage by quickly removing the vial, stoppering it with cotton and replacing it with an empty vial. Collection during heavy emergence periods required rapid movement on the part of the collectors. A few Aphidoletes escaped temporarily, but usually they could be collected from the relatively cool fluorescent tubes in the otherwise darkened room. The number of Aphidoletes permanently lost was insignificant.

The vials of emerged predators were next held to the light where a count, by sexes, could be made. Sexing in this manner proved to be simple because the longer and more definitely stalked antennae of the males, curving back over the head, were easily recognizable (figure 7). Frequently the anal claspers on the males were also visible without magnification. The abdomen of the females was usually considerably larger than the males and also assisted in separating the two sexes.

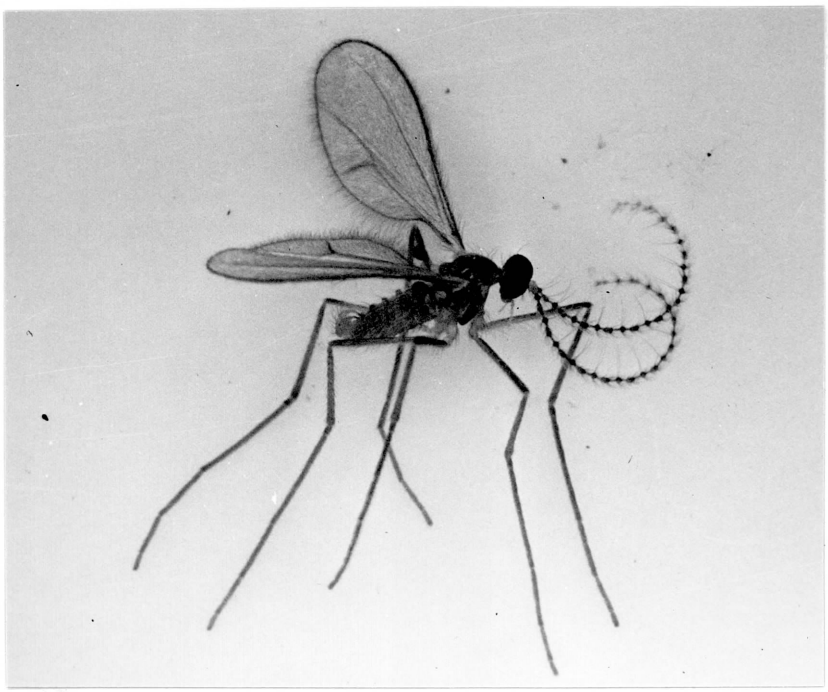

Figure 7.-Adult male Aphidoletes thompsoni (x 14)

A very small black proctotrupid parasite (probably Aphognamus nigrofornicatus) frequently emerged with the predators. When this happened, the vials were taken to an isolation room where the parasites were removed with a fine-pointed aspirator. Emergence of this parasite is shown in table 4 in the appendix.

It was recommended following 1957 rearings that larger storage and release containers be designed to hold the emerged flies. This was felt needed in order to alleviate the very tedious and cumbersome job of handling large numbers of 4-inch shell vials. Accordingly, a container or holder was designed and built as follows: The basic structure was one of the shipping boxes in which the Aphidoletes were received. A hole large enough to receive a 4-inch shell vial was bored into one side of the box. A small muslin sleeve about 1 inch in diameter and 6 inches long was fitted to the outside of this opening, and closed at the end with a spring-type paper clamp. Paper excelsior was added to the inside of the box to serve as a perch for the Aphidoletes. After the vials containing Aphidoletes were removed from the emergence cages, the cotton stopper was removed from the vial and the unstoppered end placed through the muslin tube in the box. The Aphidoletes were then blown into the box by placing ones mouth near the muslin-covered end of the vial and blowing easily. The Aphidoletes were removed from the vials quickly and without noticeable harm.

The storage and release box of predators was then kept in the refrigerator at temperatures ranging between 45° F. and 50° F. until a sufficiently large number for field release was accumulated. At this temperature, the predators walked about occasionally, but were generally quiescent, which was regarded as desirable for such a short-lived insect.

During the period July 7 to 28, a total of 2570 Aphidoletes emerged (table 3 in appendix). Of this total, 1154 were males and 1416 females, a ratio of 1:1.2. This compared to a 1957 ratio of 1:1.9. As shown in the table, males outnumbered females during the first two days of emergence, but females predominated for the balance of the rearing period.

The bulk of emergence took place from July 13-17, thus permitting rapid accumulation of large colonies. Very few of the flies were stored more than 1-1/2 days after emergence before they were released. Approximately 90 of the total emergence was kept in the laboratory for the Station collection, miscellaneous experiments, and photography.

Releases - The collection or release boxes were taken to release areas by automobile. They were transported in iced chests which maintained temperatures from 50 to 60° F. Air temperatures during transit ranged from 85° F. to 100° F., and could have caused considerable damage to the predators if the iced chests had not been used. A thermometer was carried to record chest and air temperatures at point of release.

All releases of Aphidoletes were made on a 5-inch grand fir (Abies grandis) located opposite Benton-Lane Park near Monroe, Oregon, (figure 8). There were several other trees with heavy bole infestations nearby.

Figure 8.-Releasing Aphidoletes thompsoni on chermes-infested grand fir.

Two releases were free and two were made in cages. The cage used this year was the same sleeve type as used in 1957 and is also shown in figure 8. The box of predators was set inside the cage and opened wide. The predators left the box quickly and soon scattered throughout the cage.

The balsam woolly aphid population was very heavy (about 50 wax masses per square inch) at time of release, and egg-laying adults were especially numerous.

Observations Following Release - Because all releases in 1958 were made on one tree in one area, observations could be made frequently without extensive travel. Seventeen days after the first Aphidoletes colonization was made, numerous larvae of the predator were found on the bole of the release tree, but a month after the first release (August 19) no larvae could be found. However, observations on September 4 and 17 again revealed their presence; these were probably from a succeeding generation.

Although initial establishment of the predator was secured, some fear for its permanence is felt. This is due to the extremely dry summer which caused the ground around the base of the release tree to become very hard and dry. This may have created conditions quite unfavorable for pupation.

Laboratory tests - As previously mentioned, a number of adult Aphidoletes were withheld from release for experimental use in the laboratory. A description of the two principal tests or observations follows.

A total of 60 adults (31 males and 29 females) were used to determine the length of time Aphidoletes adults will live in a refrigerator at 45° F. Under field conditions, adults are reported by European workers to survive only 4 to 6 days. If they could be held longer under refrigeration, it would be possible to schedule releases during optimum conditions of weather and development of the prey population. Results of the tests showed that the female adults lived from 5 to 16 days, with a mean of 13. Male adults, on the other hand, lived from 5 to 11 days with a mean of 7. This extension of the life period through refrigeration is encouraging. It seems likely that further extension can be secured by lowering the temperature to 40° F. or less, since Aphidoletes is still quite active at 45° F.

A small test was made to determine if Aphidoletes could be propagated in the laboratory. Fifteen males and 18 females were introduced into a frame and muslin cage in a damp sand table containing a heavily chermes-infested bolt of Abies amabilis 30 inches long and 4 inches in diameter. Temperature in the rearing room varied from 70-75°, and humidity was estimated at 60-80 percent. The predators were active in the cage for approximately one week, but no eggs or larvae could be found. Apparently, as reported by European researchers, humidity and temperature requirements for mating and oviposition are very critical and were not provided by the rearing setup used.

Other Predators Colonized in 1958

Three small lots of predators, representing three different species, were also colonized during the summer. They are described in the following section.

Cremifania nigrocellulata Cz. (Diptera: Chamaemyiidae) - This predator was collected in the pupal stage in the Bresany area, Czechoslovakia, by Dr. Zwölfer and assistants. It was shipped to Canada in the same manner as the other predators collected in Czechoslovakia. However, on arrival at Belleville the puparia were placed in rearing. After the adults emerged and passed the teneral stage, they were shipped to Portland by air express in two shipments, totalling 385 specimens (table 2). Food of unknown formula was provided in the shipping container.

The first shipment of 300 adults was cage-released on July 23 on an 11-inch Abies lasiocarpa at Willamette Pass, Oregon. The chermes population on the release tree was heavy, and the temperature was 70° F. The flies appeared to be in generally good condition, although a few had their wings tangled. The second shipment of 85 specimens was released July 26 on a hot day of 90°. This lot was also in good condition and was released in the same cage at Willamette Pass. There was some reluctance by the predators from both shipments to leave the shipping box, and flight did not occur readily.

Two larval progeny of Cremifania were found on the release tree on August 12, the first observation following release, but nothing further was found. However, the small size of the larvae coupled with their light color, which blends with the wax masses of the host, make detection difficult. Since two specimens were found, it seems likely that others were also present.

Chilocorus kuwanae (Coleoptera: Coccinellidae) - Four shipments of this predator, totalling 275 specimens, were received (table 2). All shipments originated from adults collected in Japan by P. B. Dowden of the Northeastern Forest and Range Experiment Station, who made a survey during the summer of possible chermes predators in Hokkaido prefecture. The adults were shipped to Mr. Benjamin Puttler of the Agricultural Research Service Insect Identification and Parasite Introduction Laboratory, at Riverside, California, who propagated them on mealy bugs and Latania scale until adults could be secured for shipment to Oregon. Mr. Puttler continued to rear and ship successive generations of the predators throughout the summer.

The first shipment of 70 C. kuwanae adults was received on July 8 and was released on caged chermes-infested bark in the laboratory. The beetles would not feed on the host material, and though they appeared to mate, no eggs or larvae were found. The second shipment of 46 adults and 9 pupae were received July 16 and were cage-released at Benton-Lane Park near Monroe, Oregon, on infested Abies grandis. Subsequent examinations revealed no signs of the predator.

A third shipment of 70 adults was placed on chermes-infested Abies amabilis in the laboratory on July 29. Again no feeding or reproduction occurred. The fourth and last shipment of 80 beetles was received August 27 and was free-released at Coldwater Creek near Mount St. Helens, Washington on a heavily-infested Abies amabilis tree. This colonization also appeared to be a complete failure.

It appears that C. kuwanae is not adapted for predation on Chermes piceae. From experience in California, where it has become established in some areas, its preferred hosts are coccids and related insects that attack fruit trees.

While in Japan, Mr. Dowden collected two other promising predators that feed on Chermes todomatsui Inouye. One was a coccinellid, Adalia conglomerata L. and the other was an undetermined syrphid. Collections of these were sent to the Canadian Science Service Laboratories at Fredericton, New Brunswick, and Belleville, Ontario, for propagation and study. At last reports, the Adalia had completed development on Chermes piceae, and the syrphid was still in diapause. If these predators are successful in Canada, colonies will eventually be secured for release in the Northwest. Some Adalia were also sent in the egg stage to Mr. Puttler at Riverside, but most of them died enroute. The few survivors were not successfully propagated in the laboratory. Details of Mr. Dowden's work are contained in a recent report.1/

Neoleucopis obscura (Hal.) (Diptera: chamaemyiidae) - one shipment of this small fly totalling some 700 specimens was received and colonized (table 2). It was provided by Dr. F. B. Lewis and Mr. P. B. Dowden of the New Haven Forest Insect Laboratory of the Northeastern Forest and Range Experiment Station, U. S. Forest Service. Collections were made in Maine where Neoleucopis became established following colonization in adjacent New Brunswick Province, Canada. The predators were collected by cutting bolts in the late fall from chermes-infested balsam fir, where the predator overwinters on the bark in the pupal stage. The bolts were held in cold storage until late May, when they were removed to warmer temperatures, allowing the adult flies to emerge.

1/ Office Report - Adelges todomatsui and Its Predators in Japan With Special Reference to Species Sent to the United States and Canada in 1958 by P. B. Dowden. Northeastern Forest Experiment Station, Forest Insect Laboratory, New Haven, Conn. January, 1959. Processed.

The shipment was air mailed from New York on June 5 and arrived at Portland the following morning. Total elapsed time from New York to field colonization some 80 miles from Portland was only 15 hours, indicating how air travel by direct routes can facilitate biological control work.

The insects were cage-released on a moderately-infested 8-inch Abies amabilis in the Green River drainage, Washington, in Section 4, T10N, R4E. Although the predators were in good condition when released, no trace of eggs or succeeding stages have been found. The released adults lived for about 10-14 days after colonization, and then died in the cage. The apparent failure of this predator was unexpected, since it has been readily colonized throughout eastern Canada and at several locations in the northeastern United States.

EVALUATION OF 1957 APHIDOLETES RELEASES

In July, 1957, 1830 Aphidoletes thompsoni adults were reared at the Sellwood laboratory from 10,000 larvae and puparia collected in Czechoslovakia. They were released on four trees at Black Rock, one tree near Corvallis, one tree at Coldwater Creek, and two trees at Green River. Following release at Black Rock, two larvae believed to be Aphidoletes were collected; however, since native itonidids were also present in the area, identification was not positive. No indication of successful colonization at other release points was made.

In 1958, observations on the 1957 release trees revealed successful colonization at the release point on the Toutle River - Green River divide in Section 12, T10N, R3E. This had been a cage release. Aphidoletes was observed in large numbers on the release tree from August 5 through September 23, when observations were ended for the season. A number of the larvae were brought to the laboratory where they were successfully reared to adults. It was encouraging that the predators appeared to be free of native parasites. If the predators are again abundant in 1959, they will be collected for colonization in other areas.

PROJECT PERSONNEL

The predator introduction and colonization project was under the general supervision of K. H. Wright of the Division of Forest Insect Research of the Pacific Northwest Forest and Range Experiment Station. Immediate responsibility for handling and colonizing the insects was shared by Wright and R. G. Mitchell, entomologists; and P. E. Buffam, Forestry Aid. Buffam and Mitchell made most of the post-release examinations. Technical and field assistance was provided by Dr. J. A. Rudinsky, Associate Professor of Forest Entomology at Oregon State College. Entomologist N. E. Johnson and Research Assistant J. Winjum of Weyerhaeuser Timber Company were of great help in locating suitable release trees, installing release cages, making releases, and evaluating results.

Table 2.-Shipments and colonizations of foreign predators of the balsam woolly aphid in 1958

Species	Source	Shipment no. and no. predators	Shipment date, place, and carrier 1/	Arrival date in Portland	Condition on arrival	Date of release	Location of release	No. released 2/	Temperature	Type of release	Host pop. on release tree	Species of release tree	Released by
Laricobius erichsonii (adults)	Czechoslovakia	1 - 1250	5/18 - Belleville, Ont. Air express	5/19	Good - Less than 5% mort.	(a)-5/20	Black Rock, Ore.	400	69° F.	Cage	Moderate	A. amabilis	Wright, Mitchell
						(b)-5/20	Corvallis, Ore.	325	66° F.	Cage	Heavy	A. grandis	Wright, Mitchell
						(c)-5/21	Green R., Wn.	400	72° F.	Cage	Heavy	A. amabilis	Wright, Johnson
		2 - 2580	5/21 - do.	5/24	Fair - Est. 10% mort.	(a)-5/26	Corvallis, Ore.	1380	68° F.	Free	Heavy	A. grandis	Wright, Rudinsky
						(b)-5/26	Willamette Pass, Ore.	1200	55° F.	Free	Mod.-heavy	A. lasiocarpa	Wright, Rudinsky
		3 - 3670	5/25 - do.	5/27	Fair - Est. 15% mort.	(a)-5/27	Coldwater Cr., Wn.	1320	58° F.	Free	Heavy	A. amabilis	Wright
						(b)-5/27	Green R., Wn.	1200	55° F.	Free	Heavy	A. amabilis	Wright
						(c)-5/28	Black Rock, Ore.	1150	65° F.	Free	Heavy	A. amabilis	Wright
		4 - 1150	5/26 - do.	5/29	Excellent Est. 1% mort.	5/30	Wind R., Wn.	1150	72° F.	Free	Heavy	A. lasiocarpa	Wright
	Subtotals	8650						8525					
Aphidecta obliterata (adults)	Sweden	1 - 130	5/27 - Belleville, Ont. Air express	5/31	Excellent - 2 dead	6/1	Corvallis, Ore.	130	65° F.	Free	Light-mod.	A. grandis	Mitchell
		2 - 230	6/3 - do.	6/5	Excellent - none dead	6/6	Green R., Wn.	230	50° F.	Free	Heavy	A. amabilis	Wright, Johnson
		3 - 265	6/11 - do.	6/13	Excellent - 8 dead	6/14	Corvallis, Ore.	265	60° F.	Free	Light-mod.	A. grandis	Wright, Mitchell
		4 - 95	6/16 - do.	6/18	Excellent - 1 dead	6/20	Green R., Wn.	95	70° F.	Free	Heavy	A. amabilis	Wright, Buffam
	Subtotals	720						720					
Aphidoletes thompsoni (Received as larvae and pupae--reared, and released as adults)	Czechoslovakia	1 -10000	6/27 - Belleville, Ont. Air express	6/29	Good - Est. 5% mort.	7/14	Monroe, Ore.	731	84° F.	Cage	Heavy	A. grandis	Mitchell, Buffam
						7/15	Monroe, Ore.	820	88° F.	Free	Heavy	A. grandis	Buffam
						7/16	Monroe, Ore.	694	76° F.	Cage	Heavy	A. grandis	Buffam
						7/18	Monroe, Ore.	235	75° F.	Free	Heavy	A. grandis	Mitchell
	Subtotals	10000						2480					
Cremifania nigrocellulata (adults)	Czechoslovakia	1 - 300	7/21 - Belleville, Ont. Air express	7/23	Good - A few dead	7/23	Willamette Pass, Ore.	300	70° F.	Cage	Heavy	A. lasiocarpa	Mitchell
		2 - 85	7/24 do.	7/26	Good - A few dead	7/26	Willamette Pass, Ore.	85	90° F.	Cage	Heavy	A. lasiocarpa	Buffam
	Subtotals	385						385					
Chilocorus kuwanae (adults)	Japan	1 - 70	7/7 - Riverside, Calif. Air express	7/8	Excellent - no mort.	(Kept in laboratory for experimental rearing)							
		2 - 55	7/15 do.	7/16	do.	7/16	Monroe, Ore.	55	76° F.	Cage	Heavy	A. grandis	Buffam
		3 - 70	7/27 do.	7/28	do.	(Kept in laboratory for experimental rearing)							
		4 - 80	8/25 do.	8/27	do.	8/28	Coldwater Cr., Wn.	80	60° F.	Free	Moderate	A. amabilis	Mitchell
	Subtotals	275						135					
Neoleucopis obscura (adults)	Maine	1 - 700	6/5 - New York, N.Y. Air express	6/6	Good - Est. 2% mort.	6/6	Green R., Wn.	700	55° F.	Cage	Moderate	A. amabilis	Wright, Johnson, and Winjum
	Subtotals	700						700					
	TOTALS	20730						12945					

1/ Shipments from Belleville, Ontario, travelled by train to Toronto, where they were air-expressed to Portland.

2/ Numbers are not corrected for mortality, which was generally low and could not be accurately assessed because of the urgency of prompt release of the predator colonies.

Table 3.-Summary of *Aphidoletes thompsoni* rearings--July, 1958

Box number	Number *Aphidoletes* emerging in July, by dates																		Total emergence	Grams of rearing mat.	Emergence per gram
	7	8	9	10	11	12	13	14	15	16	17	18	19	21	22	23	25	26-28			
Males																					
1					1	17	60	51	33	1		1							164	11.8 g.	13.9
2						18	54	56	25	4	1				1				159	10.9 g.	14.6
3			1			15	53	56	57	7		1	1	1					192	13.2 g.	14.5
4						11	74	78	55	10	1			14	9	1			253	11.4 g.	22.2
5		2	1			8	63	102	68	16	1		1			1			263	11.0 g.	23.9
6	1				1	1	24	39	46	10	1								123	10.1 g.	12.2
Total males	1	2	2	0	2	70	328	382	284	48	4	2	2	15	10	2			1154	68.4 g.	16.9
Females																					
1				1	1	12	38	58	43	18	1								172	11.8 g.	14.6
2					1	12	45	71	39	14	4		1	1	4		3		195	10.9 g.	17.9
3			1	1		13	38	60	56	23	3			2	1		2	2	202	13.2 g.	15.3
4				2		5	49	85	101	32	11			16	5	5	1	13	325	11.4 g.	28.5
5		7	4	3		5	55	124	125	40	8					1			372	11.0 g.	33.8
6			1			1	22	42	52	25	6		1						150	10.1 g.	14.9
Total females	0	7	6	7	2	48	247	440	416	152	33	0	2	19	10	6	6	15	1416	68.4 g.	20.7
Total males and females	1	9	8	7	4	118	575	822	700	200	37	2	4	34	20	8	6	15	2570	68.4 g.	37.6

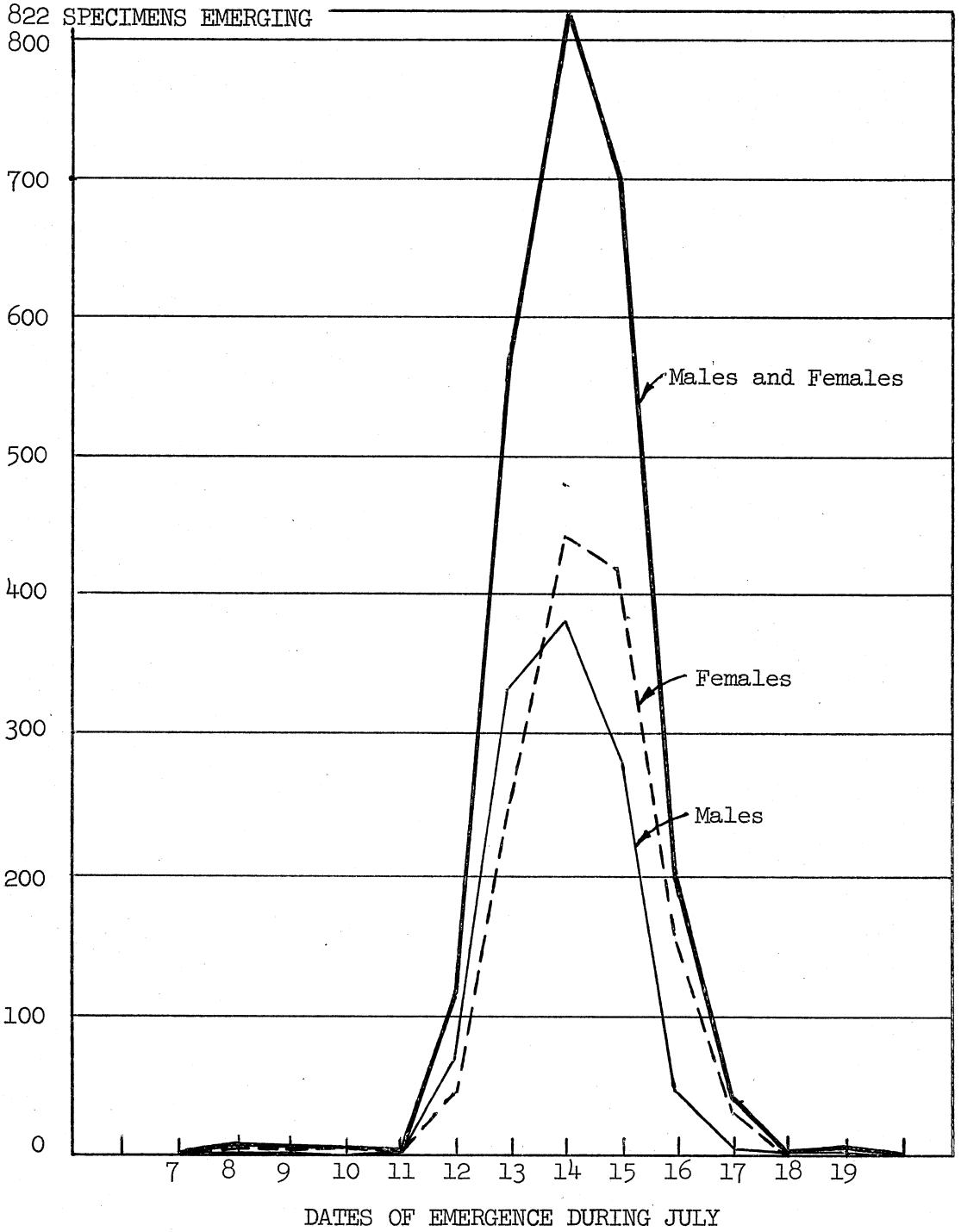

Figure 9. Emergence of Aphidoletes thompsoni reared at Sellwood Laboratory - July 1958. (Stragglers emerging after July 19th not shown).

Table 4.-Summary of proctotrupid parasite emergence from Aphidoletes rearings-1958

Cage no.	Number of proctotrupids emerging in July, by dates																		Total emergence
	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25			
1						5	15	15	5	1									41
2					1		5	18	8	5									37
3							1	2	3	12									18
4					1	5	7	10	1	1						1			26
5				1	2	9	15	25	13	2									67
6				1		1	1	8	1										12
Total	0	0	0	2	4	20	44	78	31	21	0	0	0	0	0	1			201

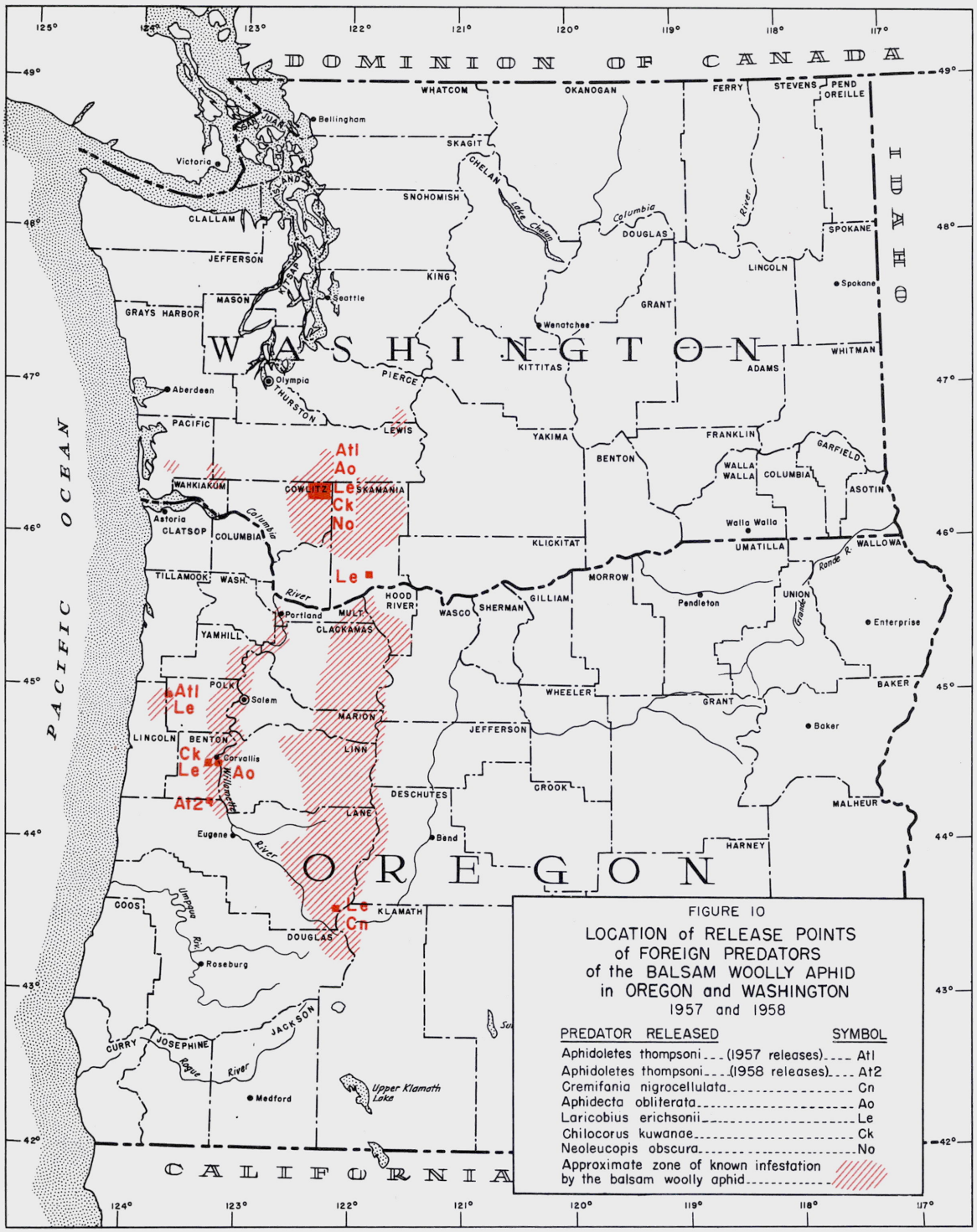

FIGURE 10

LOCATION of RELEASE POINTS of FOREIGN PREDATORS of the BALSAM WOOLLY APHID in OREGON and WASHINGTON 1957 and 1958

PREDATOR RELEASED	SYMBOL
Aphidoletes thompsoni (1957 releases)	Atl
Aphidoletes thompsoni (1958 releases)	At2
Cremifania nigrocellulata	Cn
Aphidecta obliterata	Ao
Laricobius erichsonii	Le
Chilocorus kuwanae	Ck
Neoleucopis obscura	No
Approximate zone of known infestation by the balsam woolly aphid	